

THE MIGRATION OF STEPPE EAGLES (*AQUILA NIPALENSIS*) AND OTHER RAPTORS IN CENTRAL NEPAL, AUTUMN 1999

ROBERT DECANDIDO

Department of Ecology and Evolutionary Biology, The Graduate Center of the City University of New York, Suite 4315,
365 Fifth Avenue, New York, NY 10016-4309 U.S.A.

DEBORAH ALLEN

The Linnaean Society of New York, P.O. Box 1452, Peter Stuyvesant Station, New York, NY 10009 U.S.A.

KEITH L. BILDSTEIN

Hawk Mountain Sanctuary, 1700 Hawk Mountain Road, Kempton, Pennsylvania 19529 U.S.A.

ABSTRACT.—Counts of migrating Steppe Eagles (*Aquila nipalensis*) and at least eight other species of raptors were made at Khare, a raptor-migration watchsite in central Nepal, on nine days (27 October–4 November) in autumn 1999. Totals of 821 migrating Steppe Eagles (15.2 birds/h) and 129 other migrating raptors (2.4 birds/h), including the globally vulnerable Lesser Kestrel (*Falco naumanni*) (0.2 birds/h), were seen at the watchsite. Individuals representing 10 additional species that could not be distinguished as migrants versus local residents also were seen, but were not included in the count. Most autumn migrants at Khare are believed to represent individuals from populations of raptors that breed in central and eastern Asia and overwinter in southeastern and southwestern Asia, the Indian Subcontinent, and Africa. Raptor migration appears to be a regular and predictable phenomenon at the site, leading us to recommend its use by local residents, as a source of ecotourism revenue and as a focal point for environmental-education activity for school children, and by raptor conservationists, as a continentally significant monitoring site.

KEY WORDS: *Steppe Eagle*, *Aquila nipalensis*; *Lesser Kestrel*, *Falco naumanni*; *migration*; *Central Asia*; *Nepal*.

La migración de *Aquila nipalensis* y otras aves rapaces en el centro de Nepal, otoño de 1999

RESUMEN.—Los conteos de *Aquila nipalensis* en migración y de por lo menos otras ocho especies de aves rapaces se llevaron a cabo en Khare, un observatorio de aves rapaces migratorias en el centro de Nepal durante nueve días (27 Octubre–4 Noviembre) del otoño de 1999. Un total de 821 *Aquila nipalensis* (15.2 aves/hr) y otras 129 aves rapaces migratorias (2.4 aves/hr), incluyendo el globalmente vulnerable *Falco naumanni* (0.2 aves/hr) fueron observados en este sitio. Algunos individuos que representaron 10 especies adicionales no pudieron ser identificados como migratorios versus residentes locales también fueron observados, pero no fueron incluidos en el conteo. La mayoría de los migratorios en Khare son considerados como representantes de poblaciones de aves rapaces que anidan en el centro y este del Asia y que permanecen durante el invierno en el sureste y suroeste del Asia, en el subcontinente Indio y en Africa. La migración de aves rapaces parece ser un fenómeno regular y predecible en este sitio, lo cual conlleva a la recomendación de utilizar este sitio por los pobladores locales como una fuente de ingresos a partir del ecoturismo y como un punto focal para actividades de educación ambiental para niños en edad escolar, para conservacionistas de aves rapaces y como un sitio importante de monitoreo a nivel continental.

[Traducción de César Márquez]

Central and eastern Asian breeding populations of Steppe Eagles (*Aquila nipalensis*) and other species of raptors, including the globally vulnerable Lesser Kestrel (*Falco naumanni*) (*sensu* Collar et al. 1994), as well as large numbers of Demoiselle Cranes (*Anthropoides virgo*), have been known to mi-

grate north-to-south through mountain passes in the Annapurna range of the Himalayan Mountains of central Nepal and then east-to-west along the range's southern foothills, at least since the 1970s (Ali and Ripley 1978, Fleming 1983, Inskipp and Inskipp 1991, Grimmett et al. 1999). The magni-

tude of Steppe Eagle migration in the region, the extent and location of the presumed east-to-west route used by them south of the Annapurna range, and the number of species of raptors migrating through the region remain unclear (Fleming 1983, de Roder 1989, Bijlsma 1991).

We present data on raptor migration collected at a *Hawks Aloft Worldwide* watchsite (Zalles and Bildstein 2000) near the village of Khare, in central Nepal, 150 km west-northwest of the capital of Kathmandu, and discuss use of the site and its migration by local residents and raptor conservationists.

STUDY AREA

Khare (28°20'N, 8°40'E, elevation 1646 m) is a mountaintop watchsite in a small, 50-house village along the Jomson trek, a footpath that connects the towns of Naudanda to the east and Birethane to the west, approximately 18 km northwest of Pokhara and 150 km west-northwest of Kathmandu in the Himalayan Mountains of central Nepal. The site, which sits atop an east-west, 1650 m ridge south of the Annapurna range, is directly southeast of 8090 m Annapurna I, the highest point in the region. Khare has a 360° view of the surrounding countryside, including the Yamdi Khola valley to the northeast and the Marse Khola valley to the south-southeast. Agricultural lowlands surround the site, and oak (*Quercus*)-rhododendron (*Rhododendron*) forest occurs at higher elevations (Inskipp and Inskipp 1991, Zalles and Bildstein 2000).

The watchsite and timing of our observations were chosen because earlier counts had been conducted there at approximately the same time in 1984 and 1985 (de Roder 1989, Bijlsma 1991), and because of its potential as a regionally-significant monitoring point for migratory populations of central and eastern Asian raptors (Zalles and Bildstein 2000).

METHODS

Migrating raptors were counted during 54 h and 10 min of observations on nine consecutive days (27 October–4 November) in autumn 1999. Counts were made by two observers using 10× and 8.5× binoculars for 4–7 hr daily. Observations typically began at 0900–1000 H local time and ended at 1600–1700 H. Raptors were identified to species and, when possible, Steppe Eagles were identified to age class (Grimmett et al. 1999). The species identity of several individuals was confirmed from photographs taken at the site (Porter et al. 1986, Forsman 1999, Grimmett et al. 1999). Although a few individuals, representing two species of small falcons (Eastern Red-footed Falcon [*Falco amurensis*] and Northern Hobby [*F. subbuteo*]) and at least one species of harrier (*Circus* spp.), were sometimes difficult to identify, most raptors were readily assigned to species.

Two observers (RDC and DA) scanned mainly to the east, in the direction of the small village of Naudanda, Kaskikot Hill, and, in the distance, Pokhara. Raptors, representing eight species (Western Marsh Harrier [*Circus*

aeruginosus], Eurasian Sparrowhawk [*Accipiter nisus*], Eurasian Buzzard [*Buteo buteo*], Steppe Eagle, Booted Eagle [*Hieraaetus pennatus*], Lesser Kestrel [*Falco naumanni*], Eastern Red-footed Falcon, Northern Hobby), were considered migrants if they passed east-to-west across an imaginary north-south line at the watchsite, and continued west and out of sight over a ridge approximately 1.5 km west of the site. Most Steppe Eagles were identified to species as they approached to within 1.5 km and, in many instances, their age was determined if they approached within 1.0 km.

It proved impossible to assign migrant or nonmigrant status to individuals representing 10 additional species seen at the site (Black Kite [*Milvus migrans*], Egyptian Vulture [*Neophron percnopterus*], Bearded Vulture [*Gypaetus barbatus*], Himalayan Griffon [*Gyps himalayensis*], Asian White-backed Vulture [*Gyps bengalensis*], Red-headed Vulture [*Sarcogyps calvus*], Long-legged Buzzard [*Buteo rufinus*], Asian Black Eagle [*Ictinaetus malayensis*], Crested Hawk Eagle [*Spizaetus cirrhatus*], and Eurasian Kestrel [*Falco tinnunculus*]). Observations of these species are not included in our counts of migrants.

RESULTS AND DISCUSSION

We counted 950 raptors (17.5 birds/h), representing at least nine species, migrating at the site (Table 1). Because it was not always possible to assign Eurasian Buzzards and Northern Hobbies to migrant versus nonmigrant status, and because we were conservative in classifying individuals of these two species as migrants, counts of buzzards and hobbies should be viewed as minimal estimates.

Steppe Eagles were the most common migrant, representing 86% (821 of 950 birds seen) of the flight (see also Bijlsma 1991). Eastern Red-footed Falcons and *Falco* spp., all of which almost certainly were *naumanni*, *amurensis* or *subbuteo*, made up 5% and 4% of the flight, respectively. Seventy-nine percent of the Steppe Eagles seen at the site (649 of 821 birds) were counted on three of the nine days of observation (30 and 31 October, and 3 November). Ninety-two percent of all Steppe Eagles seen were counted between 1100–1700 H, with the peak hour of eagle passage occurring at 1100–1200 H (Fig. 1). Twenty-eight percent of the Steppe Eagles seen were aged. Of these, 15% were first-year birds, 65% were subadults (2nd–4th year birds), and 20% were adults (>4th year birds) (*sensu* Grimmett et al. 1999). Species diversity was highest on the three days (i.e., 30 and 31 October, and 3 November) when most individuals were counted. On these three days, migrant species totaled 6, 6, and 4, respectively (Table 1).

Although a few raptors migrated east-to-west south of the site, most migrants passed east-to-west directly overhead, or within 750 m north of the

Table 1. Daily counts of migrants at the Khare raptor-migration watchsite, central Nepal, 27 October–3 November 1999.

SPECIES	OCTOBER					NOVEMBER				ALL DAYS
	27	28	29	30	31	1	2	3	4	
Western Marsh Harrier (<i>Circus aeruginosus</i>)	0	0	0	0	0	0	0	1	0	1
Harriers (<i>Circus</i> spp.)	0	0	0	0	1	0	0	1	1	3
Eurasian Sparrowhawk (<i>Accipiter nisus</i>)	0	0	0	1	1	1	0	0	0	3
Eurasian Buzzard (<i>Buteo buteo</i>)	0	1	0	2	1	0	0	0	0	4
Buzzard (<i>Buteo</i> spp.)	0	0	1	0	0	0	0	0	0	1
Steppe Eagle (<i>Aquila nipalensis</i>)	0	1	14	176	231	70	64	238	27	821
Booted Eagle (<i>Hieraaetus pennatus</i>)	0	0	0	0	0	1	1	0	1	3
Lesser Kestrel (<i>Falco naumanni</i>)	0	0	0	5	0	0	1	4	0	10
Eastern Red-footed Falcon (<i>F. amurensis</i>)	0	1	4	34	0	4	0	0	0	43
Northern Hobby (<i>F. subbuteo</i>)	0	0	3	9	6	0	0	1	0	19
Small falcons (<i>Falco</i> spp.)	0	0	0	30	10	0	0	0	0	40
Large falcons (<i>Falco</i> spp.)	0	0	0	0	1	0	0	0	0	1
All species	0	3	22	257	252	76	66	245	29	950
Hours of observation	5.33	6	5	6.5	7	6.5	5.75	5.83	4.25	54.16

site. Those passing overhead migrated at 25–75 m above the surrounding landscape. Most eagles were first detected soaring in thermals above the Yamdi Khola valley north of Naudanda and east of the site, and along a lower ridge between Naudanda and the watchsite. Eagles seen thermaling and

riding on updrafts in the distance typically passed the watchsite within 5–7 min.

DISCUSSION

Regional cloud cover appeared to have a profound affect on the numbers of eagles counted at the site. Two of the three highest daily counts for eagles, 30 October and 3 November, occurred on days when clouds began to build over the Annapurna range earlier than on other days, and when the range’s foothills were covered in clouds by 0930 H. It appeared that heavy cloud cover forced eagles to shift their flight path south of the range and toward the hills and valleys near the watchsite (Fleming 1983, de Roder 1989). Indeed, our highest hourly count of eagles (149 birds) occurred at 1100–1200 H on 31 October, the same hour in which clouds completely obscured both the massif and its foothills that day.

Neither wind speed nor wind direction, both of which remained relatively constant at <20 kph from the south, varied sufficiently during our ob-

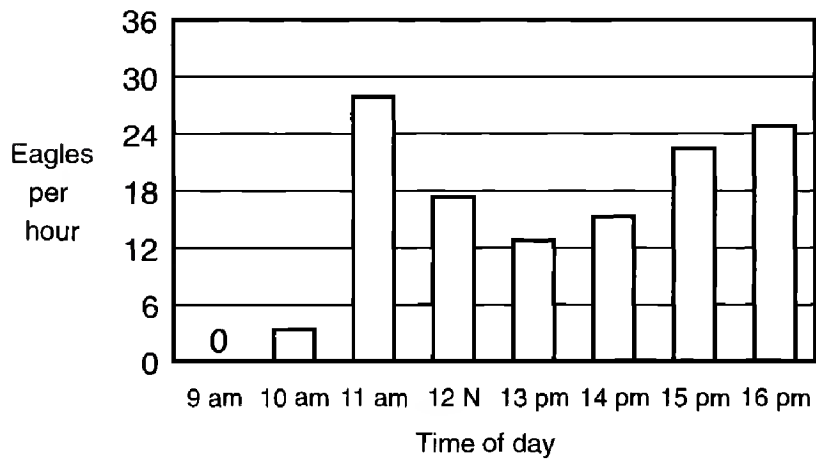


Figure 1. Passage rates of Steppe Eagles (*Aquila nipalensis*) by time of day at the Khare raptor migration watchsite in central Nepal, 27 October–4 November 1999.

servations to allow us to determine their effect, if any, on raptor migration at the site.

Our observations of the diurnal periodicity of the flight, which indicate a decided peak at 1100–1200 H (Fig. 1), followed by a second peak in late afternoon, are similar to those of de Roder (1989), who also noted that the greatest movements of eagles occurred between midday and late afternoon. Possible explanations for the diurnal periodicity include the location of appropriate roosting areas several hours flying-time to the east, and the diurnal shifts in soaring conditions at the site, both of which merit additional investigation.

A large-scale, east-to-west, autumn movement of *Aquila* eagles along the southern foothills of the Himalayan Mountains was first observed by R.L. Fleming, Jr. in 1983 (Fleming 1983). The 821 eagles we counted over 9 d in late October–early November 1999, together with the 1100 seen by Bijlsma (1991) in approximately the same area over the same 9 d in 1984, and the 4907 seen by de Roder (1989) at Khare during the same 9 d in 1985, largely confirm Fleming’s initial description of the flight. The route, which apparently results when south-bound migrants from central and east Asia detour around the eastern flank of the Tibetan Plateau, enables the birds to soar on updrafts and thermals along the southern foothills of the Himalayan Mountains of Nepal, and presumably, northern India (Fleming 1983, Bijlsma 1991). Although the ultimate destination of the birds is thought to be southern Asia, including India and possibly Arabia, some of the birds may reach Africa (Welch and Welch 1991).

Still unclear, however, is the seasonal magnitude of the flight, which to date has been observed for only relatively brief periods of time in any one autumn (i.e., 25 d in 1984, 18 d in 1985, and 9 d in 1999). Fleming (1983) estimated a seasonal passage of at least 45 000 eagles, while de Roder (1989) estimated the passage at between 10 000–20 000 individuals. Our observations lead us to suggest that while >10 000 eagles probably do pass the site in most autumns (see Zalles and Bildstein 2000), additional season-long observations (i.e., late September–early December) are needed to provide more accurate estimates of the magnitude of the flight.

In addition to Steppe Eagles, we identified 18 additional species of raptors at the site, at least eight of which certainly included migratory individuals (Table 1). Fleming (1983) initially reported

Table 2. Raptors reported as migrants at or near the Khare raptor-migration watchsite in central Nepal.

SPECIES	SOURCE ^a
Eastern Honey Buzzard (<i>Pernis ptilorhynchus</i>) ^b	1, 3
Black Kite (<i>Milvus migrans</i>)	1, 2, 3, this study ^c
White-tailed Sea Eagle (<i>Haliaeetus albicilla</i>) ^b	2, 3
Black Vulture (<i>Aegypius monachus</i>) ^b	2, 3
Egyptian Vulture (<i>Neophron percnopterus</i>)	1, 2, 3
Short-toed Eagle (<i>Circaetus gallicus</i>) ^b	2, 3
Western Marsh Harrier (<i>Circus aeruginosus</i>) ^b	This study
Hen Harrier (<i>C. cyaneus</i>)	1, 2, 3
Pallid Harrier (<i>C. macrourus</i>) ^b	1, 3
Montagu’s Harrier (<i>C. pygargus</i>) ^b	1, 3
Besra (<i>Accipiter virgatus</i>)	1, 3
Shikra (<i>A. badius</i>) ^b	1, 3
Eurasian Sparrowhawk (<i>A. nisus</i>) ^b	1, 2, 3, this study
Eurasian Buzzard (<i>Buteo buteo</i>)	1, 2, 3, this study
Long-legged Buzzard (<i>B. rufinus</i>)	1, 2, 3, this study
Steppe Eagle (<i>Aquila nipalensis</i>)	1, 2, 3, this study
Imperial Eagle (<i>A. heliaca</i>)	1, 2, 3
Booted Eagle (<i>Hieraaetus pennatus</i>)	2, this study
Lesser Kestrel (<i>Falco naumanni</i>)	1, 2, 3, this study
Eurasian Kestrel (<i>F. tinnunculus</i>)	2
Eastern Red-footed Falcon (<i>F. amurensis</i>)	1, 2, 3, this study
Northern Hobby (<i>F. subbuteo</i>)	2, this study
Saker Falcon (<i>F. cherrug</i>) ^b	1, 3
Peregrine Falcon (<i>F. peregrinus</i>) ^b	1, 3
Barbary Falcon (<i>F. pelegrinoides</i>) ^b	1, 3

^a 1—de Roder (1989), 2—Bijlsma (1991), 3—Zalles and Bildstein (2000).

^b Irregular or uncommon migrant.

^c Seen in 1999, but not separated numerically from local residents.

that at least five species used the corridor, de Roder (1989) reported 18 species, and Bijlsma (1991) 16 species. Zalles and Bildstein (2000) summarizing these earlier efforts, suggested that 21 species regularly migrate at the site (Table 2).

RECOMMENDATIONS

Our observations, together with those of Fleming (1983), de Roder (1989), and Bijlsma (1991), confirm a significant east-west movement of Steppe

Eagles and smaller numbers of as many as 20 other species of raptors through the region. One of the species migrating at the site, the Lesser Kestrel, is a globally vulnerable raptor whose western European populations recently have declined precipitously and whose central Asia populations are little studied (Collar et al. 1994). It may merit additional monitoring at the site (Zalles and Bildstein 2000).

The fairly-consistent nature of the flight (local weather conditions notwithstanding) suggests that the Khare watchsite has potential for monitoring regional populations of central and east Asia migratory raptors, and for serving as an environmental education center for local inhabitants and as a source of ecotourism revenue. Indeed, during our stay at Khare we were visited by a teacher from a local school, along with several of his students, all of whom were both curious and enthusiastic about our activities. Although local villagers were able to distinguish vultures from other raptors, none was aware of the substantial migration of Steppe Eagles and other birds of prey. Nepalese schools are in recess from mid-October through mid-November, presenting an ideal opportunity to train and use students to monitor the migration on a long-term basis.

ACKNOWLEDGMENTS

We sincerely appreciate the encouragement and thoughtful advice of P. Kerlinger, as well as the comments and suggestions of A. Fish, J. Smith, and R. Yosef on an earlier version of the manuscript. M. Gauchan and her family provided a home-style atmosphere at the Gauchan Lodge during our stay in Naudanda, Nepal. We also gratefully acknowledge the many kind gestures of friendship shown to us by local teacher, S. Gurung, and his son, Sumit, in Khare. Those wishing to visit and stay at the site can contact Mr. Gurung at Balmandir English School,

LARC, P.O. Box No. 1 Pokhara, Gandaki Zone, Nepal. This is Hawk Mountain Sanctuary contribution number 45.

LITERATURE CITED

- ALI, S. AND S.D. RIPLEY. 1978. Handbook of the birds of India and Pakistan. Vol. 1. 2nd Ed. Oxford Univ. Press, Bombay, India.
- BIJLSMA, R.G. 1991. Migration of raptors and Demoiselle Cranes over central Nepal. *Birds Prey Bull.* 4:73–80.
- COLLAR, N.J., M.J. CROSBY, AND A.J. STATTERSFIELD. 1994. Birds to watch 2: the world list of threatened birds. BirdLife Conservation Series No. 4. Birdlife International, Cambridge, U.K.
- DE RODER, F.E. 1989. The migration of raptors south of Annapurna, Nepal, autumn 1985. *Forktail* 4:9–17.
- FLEMING, R.L., JR. 1983. An east-west *Aquila* eagle migration in the Himalayas. *J. Bombay Nat. Hist. Soc.* 80:58–62.
- FORSMAN, D. 1999. The raptors of Europe and the Middle East: a handbook of field identification. T. & A.D. Poyser, Calton, U.K.
- GRIMMETT, R., C. INSKIPP, AND T. INSKIPP. 1999. A guide to the birds of India, Pakistan, Nepal, Bangladesh, Bhutan, Sri Lanka, and the Maldives. Princeton Univ. Press, Princeton, NJ U.S.A.
- INSKIPP, C. AND T. INSKIPP. 1991. A guide to the birds of Nepal, 2nd Ed. Christopher Helm, London, U.K.
- PORTER, R.F., L. WILLIS, S. CHRISTENSEN, AND B.P. NIELSEN. 1986. Flight identification guide of European raptors, 3rd Ed. T. & A.D. Poyser, Calton, U.K.
- WELCH, G. AND H. WELCH. 1991. The autumn migration of the Steppe Eagle *Aquila nipalensis*. *Sandgrouse* 13 24–33.
- ZALLES, J.I. AND K.L. BILDSTEIN. 2000. Raptor watch: a global directory of raptor migration sites. BirdLife International, Cambridge, U.K.; and Hawk Mountain Sanctuary, Kempton, PA U.S.A.

Received 3 March 2000; accepted 26 October 2000